NAS Enterprise Architecture

Presented at: National CM Training Workshop

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Why Architect ?

- ***Enterprise architecture (EA)*** **provides the *structure* to *relate* organizational mission, vision, and goals to business processes and the technical or IT infrastructure required to execute them**
  - An orderly arrangement of parts; structure - a style and method of design and construction

Stairs to Nowhere

- **System architecture relates requirements and the external world to system structures, including both hardware and software, so that the effectiveness of a system design concept can be communicated**
- **Software architecture relates requirements, fixed system hardware, and infrastructure to software structures in order to demonstrate software effectiveness**

You'll recognize these…

But maybe not this…

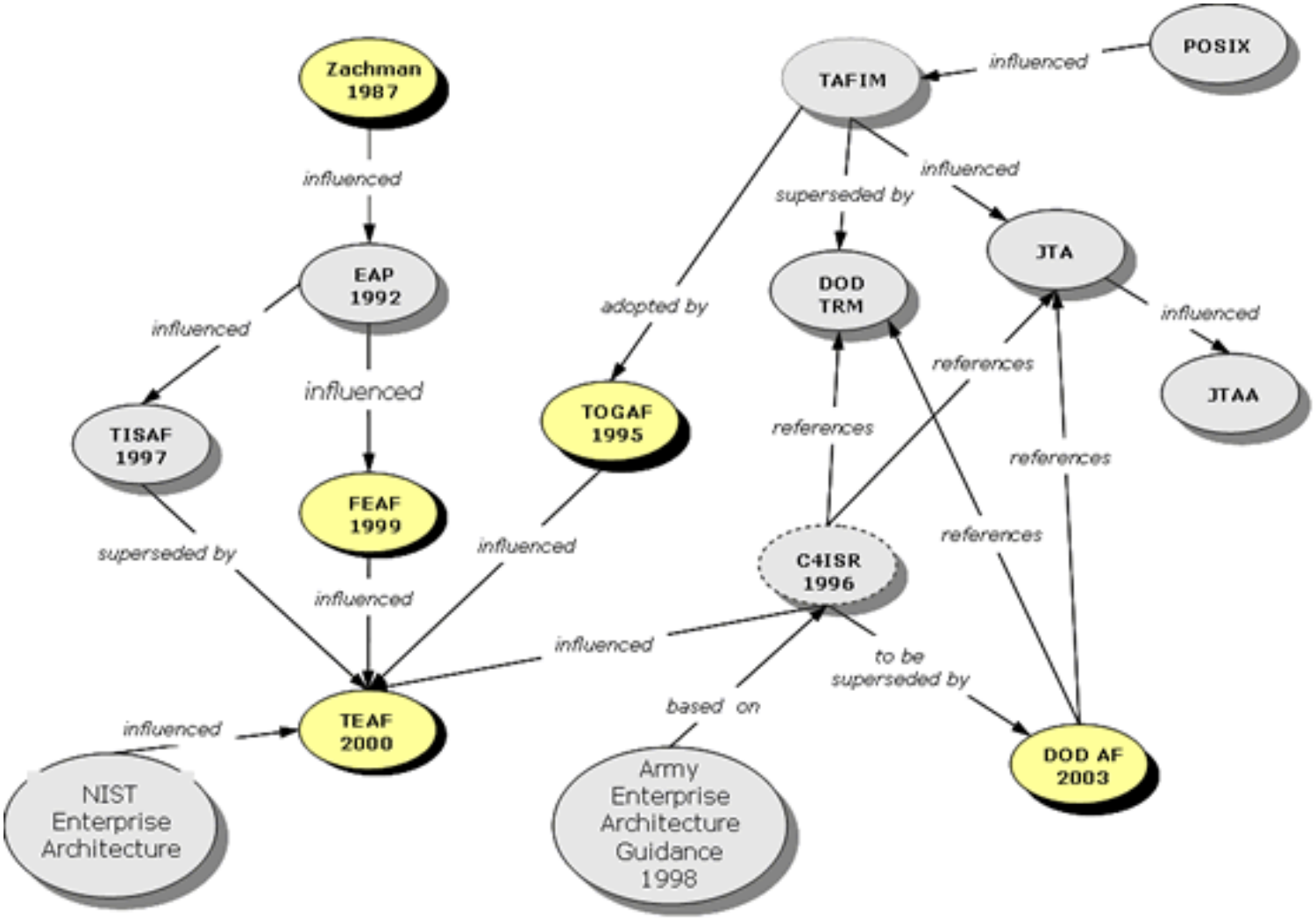
Door to Nowhere

Background & History

- **Clinger Cohen Act – 1996 (formerly IT Mgmt Reform Act – ITMRA)**
  - Authorized a CIO for all Federal Agencies
  - CIO responsible for developing, maintaining, and facilitating implementation of an integrated IT architecture – ***"the enterprise architecture"***
- **Exec Order 13011 est. CIO Council**
  - Improve Agency practices related to design, acquisition, development, modernization, use, sharing, and performance of Federal Gov't information resources
- **OMB requires all Agency budget submissions to include:**
  - Exhibit 300, Capital Assess Plan and Business Case and Exhibit 53 Report on IT for all major investments

Reduce inefficiency and duplication of effort and provide a framework to relate technology to business and mission needs…

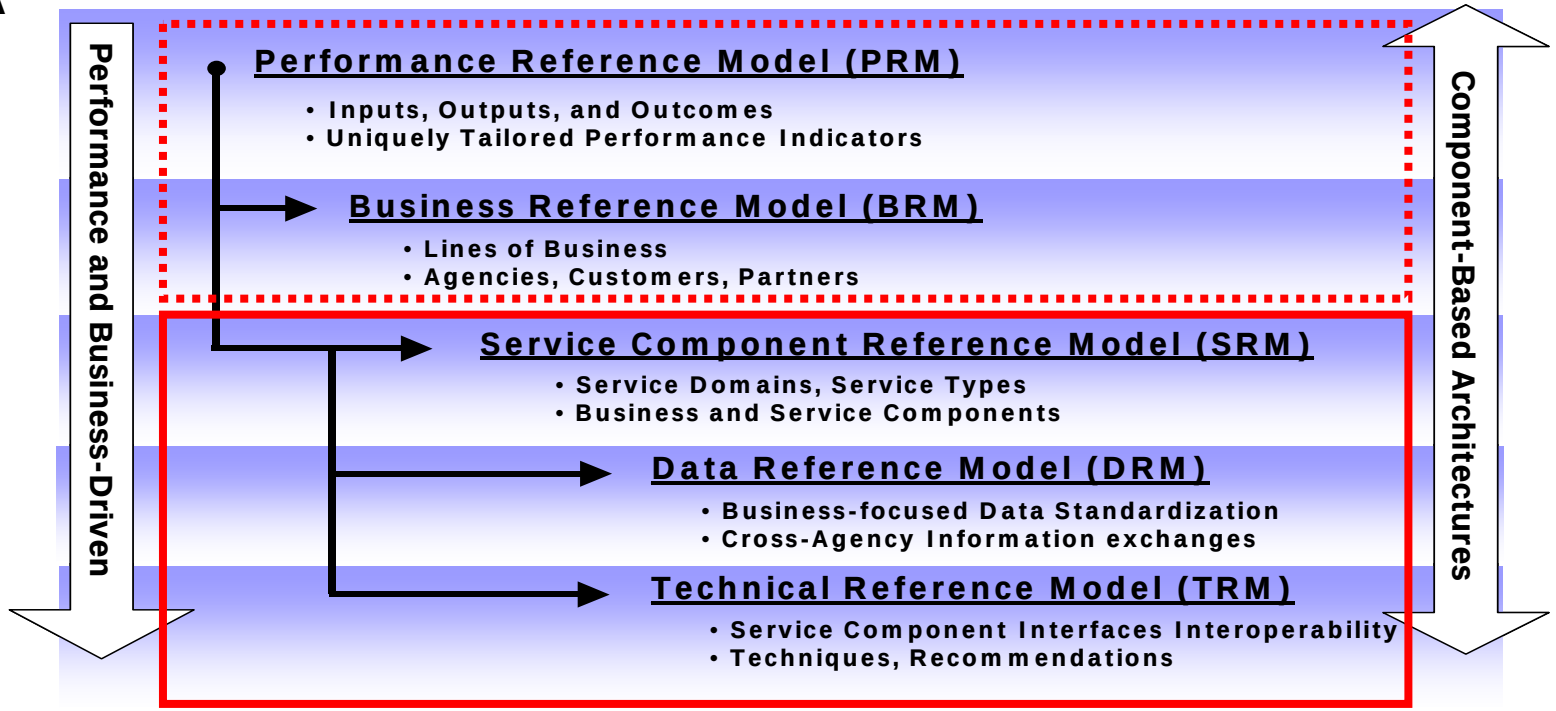
EA Evolution…



The Federal Enterprise Architecture

- **Starting in FY '05, all IT investments over $500K must demonstrate alignment to the FEA**

FEA

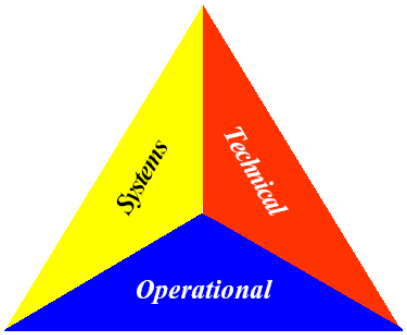


Why EA?

People Process Technology Business

- Improve the ***alignment*** of systems and technologies with the mission/business needs of the operators and the organization
- ***Identify*** duplication of effort in mission and IT expenditures and facilitate the reduction of investments where applicable
- ***Address*** the need for increased efficiency in information exchange and interoperability
- ***Provide*** a common language to facilitate linkages and communications between complex architectures & organizations
- Provide a unifying approach to minimize the burden for the collection, storage, and access to data
- ***Facilitate*** efficient identification of necessary changes and change implementation – identifies reuse opportunities
- Helps provide a framework for managing change during spiral and evolutionary development
- And, because the OMB and GAO says so

DoD Architecture Framework (DoDAF)



All Views

Identification, Scope, Viewpoint, and context of the Architecture

•Operational View

•Identifies Users
•Relationships and Information Needs

Processing and Inter-nodal Levels of Information Exchange Requirements

Systems Associations to Nodes, Activities Needlines and Requirements

An integrated architecture with three types of views…

Processing and Levels of Information Exchange Requirements

Basic Technology Supportability and New Capabilities

Specific Capabilities Identified to Satisfy Information Exchange Levels and Other Operational Requirements

•Technical View

•Prescribes Standards and
•Conventions

•Systems View

•Relates Capabilities and Characteristics
•to Operational Requirements

Technical Criteria Governing Interoperable Implementation/ Procurement of the Selected System Capabilities

DoDAF Views

- **Operational View**

  "The OV is a description of the tasks and activities, operational elements, and information exchanges required to accomplish DoD missions."

- **Systems View**

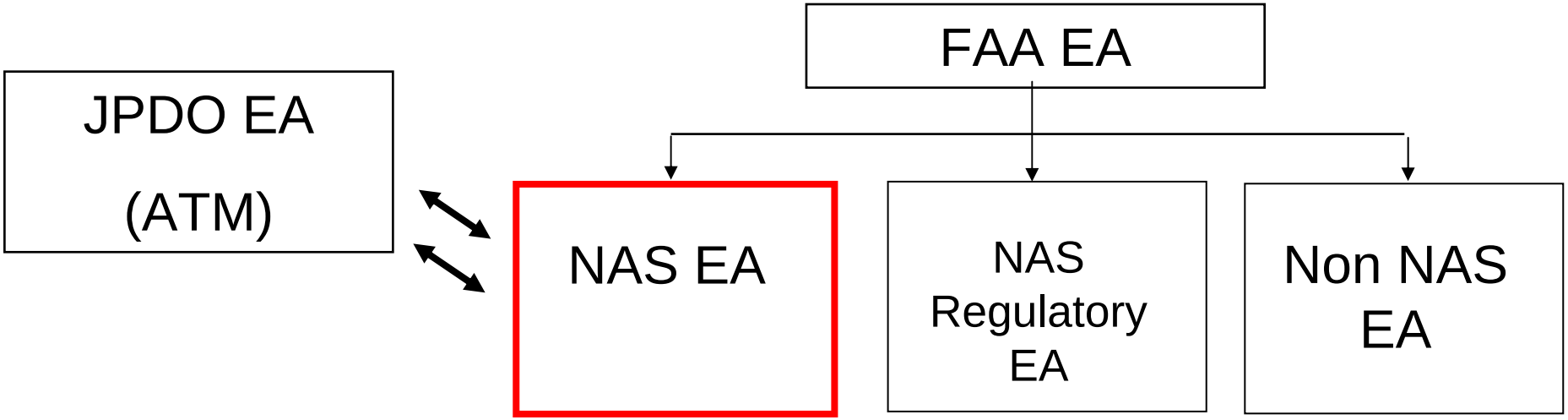
  "The SV is a set of graphical and textual products that describes systems and interconnections providing for, or supporting, DoD functions."

- **Technical View**

  "The TV is the minimal set of rules governing the arrangement, interaction, and interdependence of system parts or elements. Its purpose is to ensure that a systems satisfies a specified set of operational requirements."

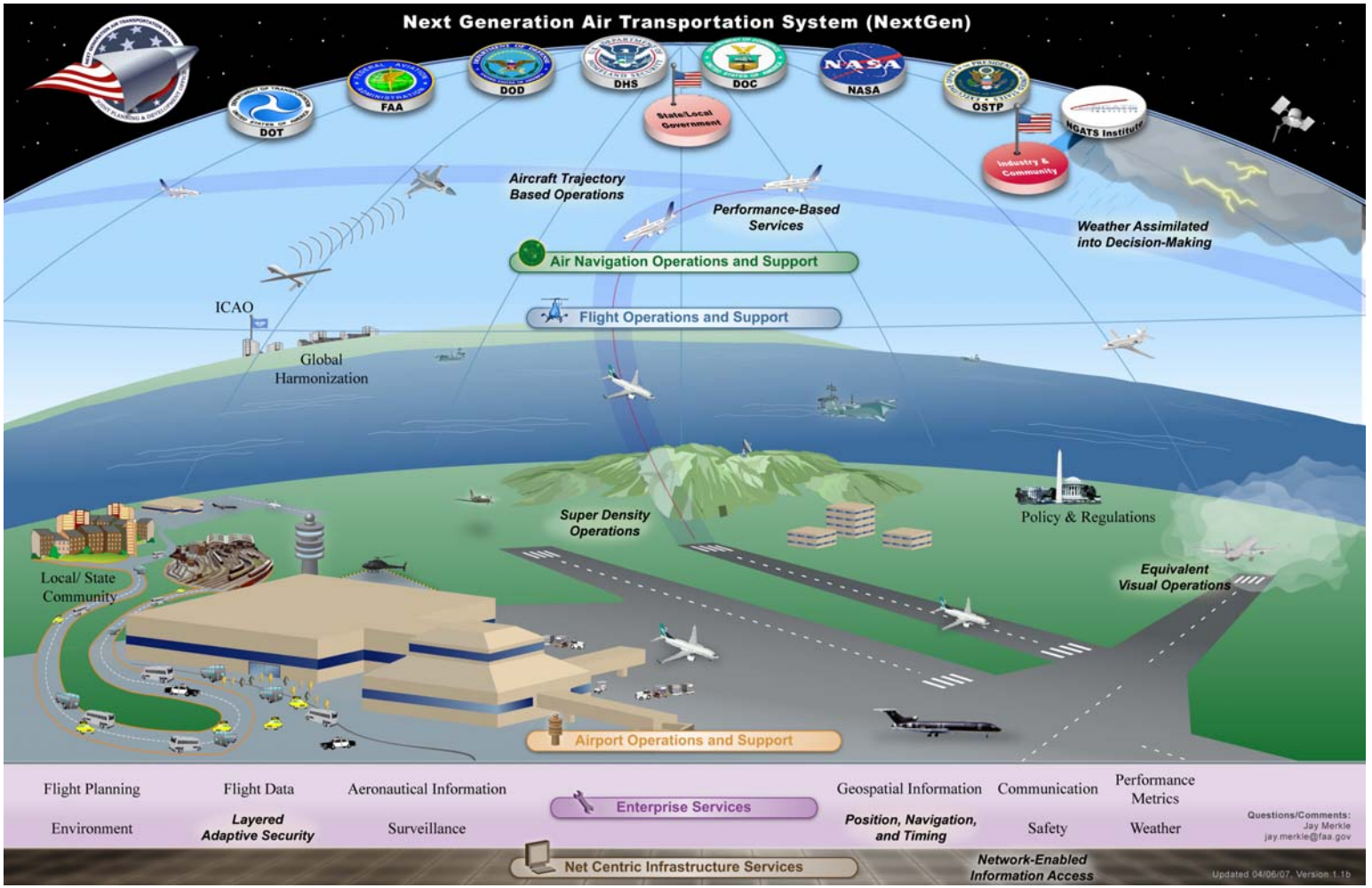
Applicable View	Framework Product	Framework Product Name	General Description
All Views	AV-1	Overview and Summary Information	Scope, purpose, intended users, environment depicted, analytical findings
All Views	AV-2	Integrated Dictionary	Architecture data repository with definitions of all terms used in all products
Operational	OV-1	High-Level Operational Concept Graphic	High-level graphical/textual description of operational concept
Operational	OV-2	Operational Node Connectivity Description	Operational nodes, connectivity, and information exchange needlines between nodes
Operational	OV-3	Operational Information Exchange Matrix	Information exchanged between nodes and the relevant attributes of that exchange
Operational	OV-4	Organizational Relationships Chart	Organizational, role, or other relationships among organizations
Operational	OV-5	Operational Activity Model	Capabilities, operational activities, relationships among activities, inputs, and outputs; overlays can show cost, performing nodes, or other pertinent information
Operational	OV-6a	Operational Rules Model	One of three products used to describe operational activity—identifies business rules that constrain operation
Operational	OV-6b	Operational State Transition Description	One of three products used to describe operational activity—identifies business process responses to events
Operational	OV-6c	Operational Event-Trace Description	One of three products used to describe operational activity—traces actions in a scenario or sequence of events
Operational	OV-7	Logical Data Model	Documentation of the system data requirements and structural business process rules of the Operational View
Systems	SV-1	Systems Interface Description	Identification of systems nodes, systems, and system items and their interconnections, within and between nodes
Systems	SV-2	Systems Communications Description	Systems nodes, systems, and system items, and their related communications lay-downs
Systems	SV-3	Systems-Systems Matrix	Relationships among systems in a given architecture; can be designed to show relationships of interest, e.g., system-type interfaces, planned vs. existing interfaces, etc.
Systems	SV-4	Systems Functionality Description	Functions performed by systems and the system data flows among system functions
Systems	SV-5	Operational Activity to Systems Function Traceability Matrix	Mapping of systems back to capabilities or of system functions back to operational activities
Systems	SV-6	Systems Data Exchange Matrix	Provides details of system data elements being exchanged between systems and the attributes of that exchange
Systems	SV-7	Systems Performance Parameters Matrix	Performance characteristics of Systems View elements for the appropriate time frame(s)
Systems	SV-8	Systems Evolution Description	Planned incremental steps toward migrating a suite of systems to a more efficient suite, or toward evolving a current system to a future implementation
Systems	SV-9	Systems Technology Forecast	Emerging technologies and software/hardware products that are expected to be available in a given set of time frames and that will affect future development of the architecture
Systems	SV-10a	Systems Rules Model	One of three products used to describe system functionality—identifies constraints that are imposed on systems functionality due to some aspect of systems design or implementation
Systems	SV-10b	Systems State Transition Description	One of three products used to describe system functionality—identifies responses of a system to events
Systems	SV-10c	Systems Event-Trace Description	One of three products used to describe system functionality—identifies system-specific refinements of critical sequences of events described in the Operational View
Systems	SV-11	Physical Schema	Physical implementation of the Logical Data Model entities, e.g., message formats, file structures, physical schema
Technical	TV-1	Technical Standards Profile	Listing of standards that apply to Systems View elements in a given architecture
Technical	TV-2	Technical Standards Forecast	Description of emerging standards and potential impact on current Systems View elements, within a set of time frames

FAA Enterprise Architecture



- FAA Enterprise Architecture (EA) has three parts
  - NAS - Activities that support Operational Air Traffic Services
  - Regulatory - Activities that support the FAA Mission
  - Administrative - Activities that support operation of the FAA
- FAA CIO has responsibility for entire FAA EA - Delegates responsibility to develop and implement NAS EA to ATO COO

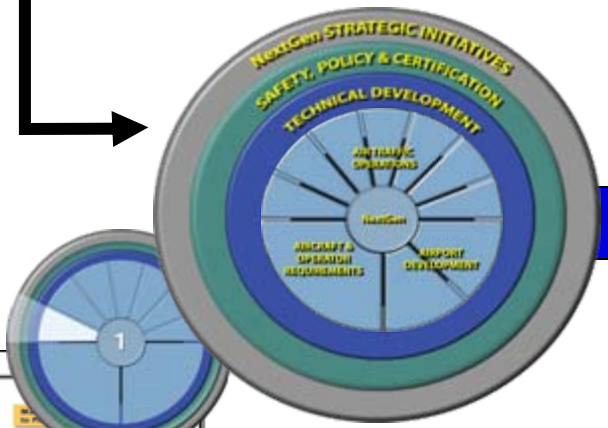
OV-1 for NextGen



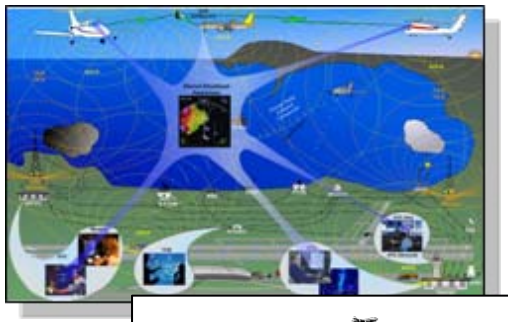
Courtesy: JPDO

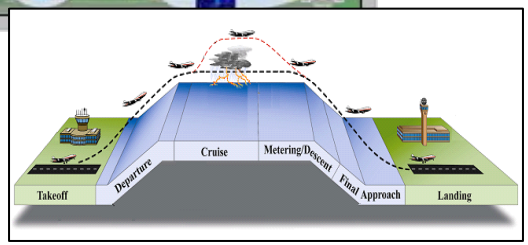
NextGen Key Capabilities

- Initiate Trajectory Based Ops
- Increase Arrivals/Departures at High Density Airports
- Increase Flexibility in the Terminal Environment
- Improve Collaborative ATM
- Reduce Wx Impact
- Increase Security and Safety Performance
- Increase Environmental Performance
- Transform Facilities

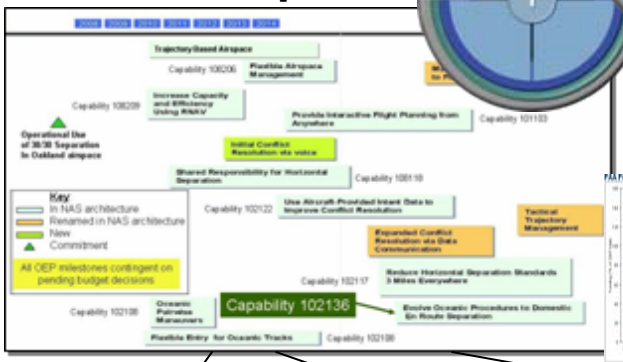


NASEA





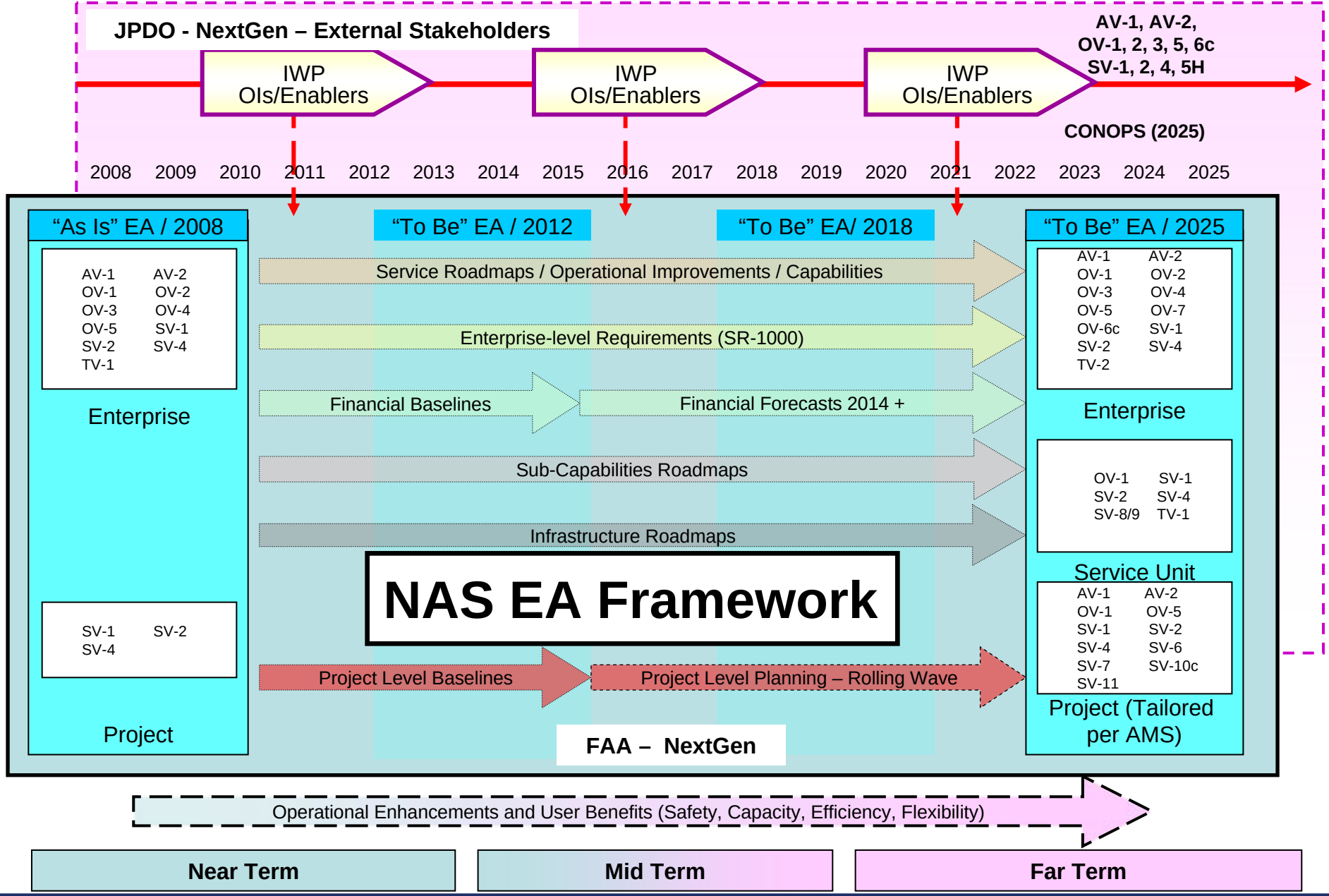
Roadmap



Courtesy: JPDO

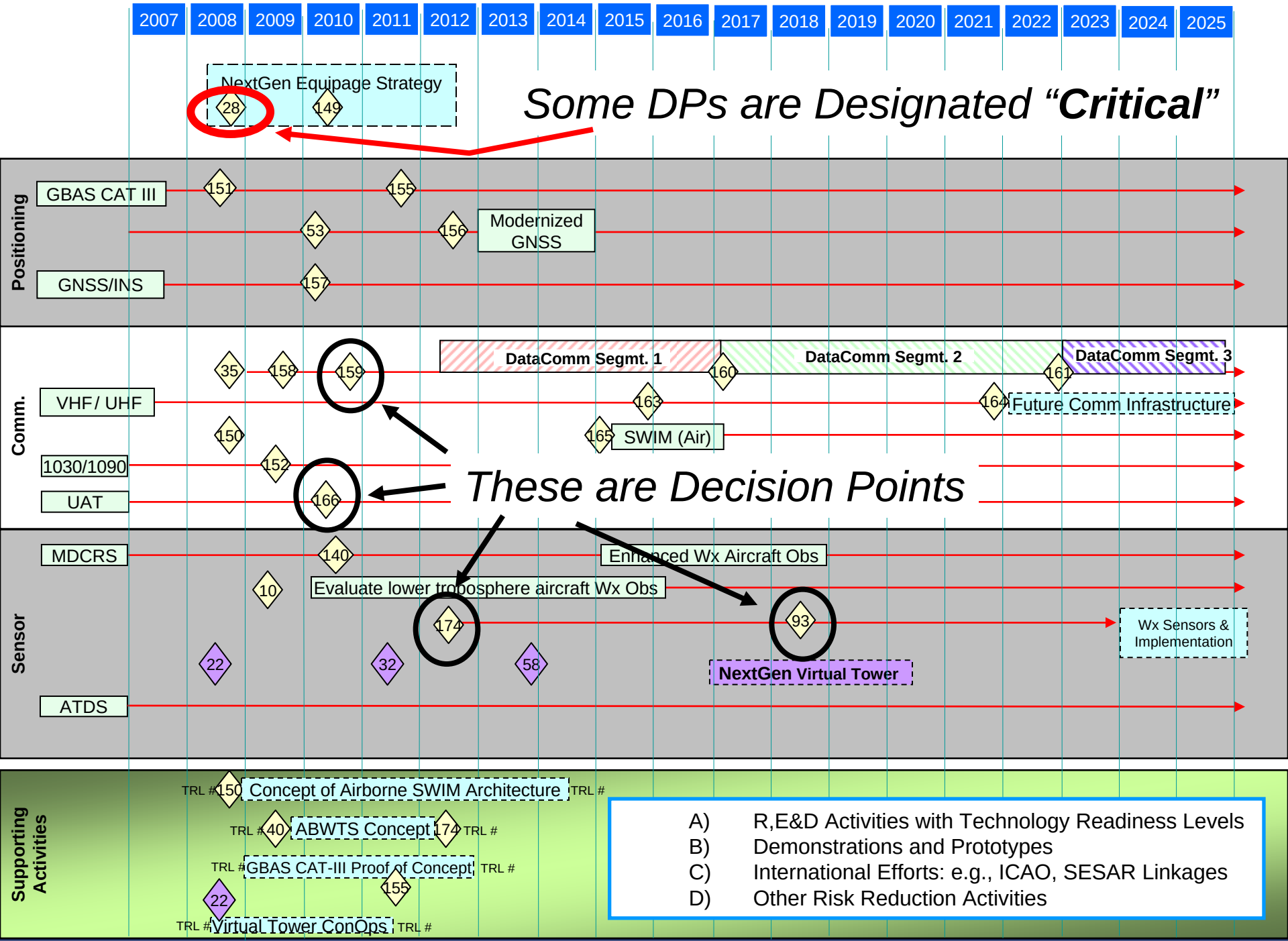
Programs

En Route Automation Modernization (ERAM)	*NextGen Collision Avoidance System*	*NextGen Traffic Flow Management*	*SWIM*	*Aeronautical Data Link*


JPDO - NextGen – External Stakeholders
IWP OIs/Enablers
IWP OIs/Enablers
IWP OIs/Enablers
AV-1, AV-2, OV-1, 2, 3, 5, 6c SV-1, 2, 4, 5H
CONOPS (2025)
2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 2023 2024 2025
"As Is" EA / 2008
"To Be" EA / 2012
"To Be" EA/ 2018
"To Be" EA / 2025
AV-1 AV-2 OV-1 OV-2 OV-3 OV-4 OV-5 SV-1 SV-2 SV-4 TV-1
Enterprise
SV-1 SV-2 SV-4
Project
Service Roadmaps / Operational Improvements / Capabilities
Enterprise-level Requirements (SR-1000)
Financial Baselines
Financial Forecasts 2014 +
Sub-Capabilities Roadmaps
Infrastructure Roadmaps
NAS EA Framework
Project Level Baselines
Project Level Planning – Rolling Wave
FAA – NextGen
AV-1 AV-2 OV-1 OV-2 OV-3 OV-4 OV-5 OV-7 OV-6c SV-1 SV-2 SV-4 TV-2
Enterprise
OV-1 SV-1 SV-2 SV-4 SV-8/9 TV-1
Service Unit
AV-1 AV-2 OV-1 OV-5 SV-1 SV-2 SV-4 SV-6 SV-7 SV-10c SV-11
Project (Tailored per AMS)
Operational Enhancements and User Benefits (Safety, Capacity, Efficiency, Flexibility)
Near Term
Mid Term
Far Term

Infrastructure Roadmaps

- **Infrastructure Roadmaps are Updated Annually**
  - Iterative process within a “swim lane”
  - “Swim Lanes” for this year’s update are:
    - Automation, Aircraft, Air-to-Ground, Airspace & Procedures, Communications, Facilities, Navigation, Surveillance, Weather, Enterprise Services, Personnel, Security, Safety
  - Roadmaps capture decision points, assumptions, and dependencies
  - Infrastructure Roadmaps will be mapped to sub-capabilities and to the Solution Set OIs for this year’s update
  - Final products capture contributions from ATO service units, AVS, etc.


2007
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2016
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2018
2019
2020
2021
2022
2023
2024
2025
NextGen Equipage Strategy
28
149
Some DPs are Designated "Critical"
Positioning
GBAS CAT III
151
155
53
156
Modernized GNSS
GNSS/INS
157
Comm.
DataComm Segmt. 1
DataComm Segmt. 2
DataComm Segmt. 3
35
158
159
160
161
VHF/ UHF
163
164
Future Comm Infrastructure
150
165
SWIM (Air)
1030/1090
152
UAT
166
These are Decision Points
Sensor
MDCRS
140
Enhanced Wx Aircraft Obs
10
Evaluate lower troposphere aircraft Wx Obs
174
93
Wx Sensors & Implementation
22
32
58
NextGen Virtual Tower
ATDS
Supporting Activities
TRL #
150
Concept of Airborne SWIM Architecture
TRL #
TRL #
40
ABWTS Concept
174
TRL #
TRL #
GBAS CAT-III Proof of Concept
TRL #
155
22
TRL #
Virtual Tower ConOps
TRL #
A) R,E&D Activities with Technology Readiness Levels
B) Demonstrations and Prototypes
C) International Efforts: e.g., ICAO, SESAR Linkages
D) Other Risk Reduction Activities

Sample OI/Capability to Sub-capability to Infrastructure Roadmaps Mapping

2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 2023 2024 2025 2026

Solution Set Capabilities / OIs

Initiate Trajectory Based Operations

Separation reduction - 50 longitudinal miles in Anchorage Oceanic airspace

50 nmi Lateral Separation in WATRS

ADS-B in Gulf Of Mexico

OEP/OI [102118] Delegated Responsibility for Separation

OEP/OI [102108] Oceanic In-Trail Climb and Descent

Etc. Etc. Etc.

Tactical Trajectory Management

Reduce Horizontal Separation Standards - 3 Miles

NextGen Oceanic Procedures

Separation Management

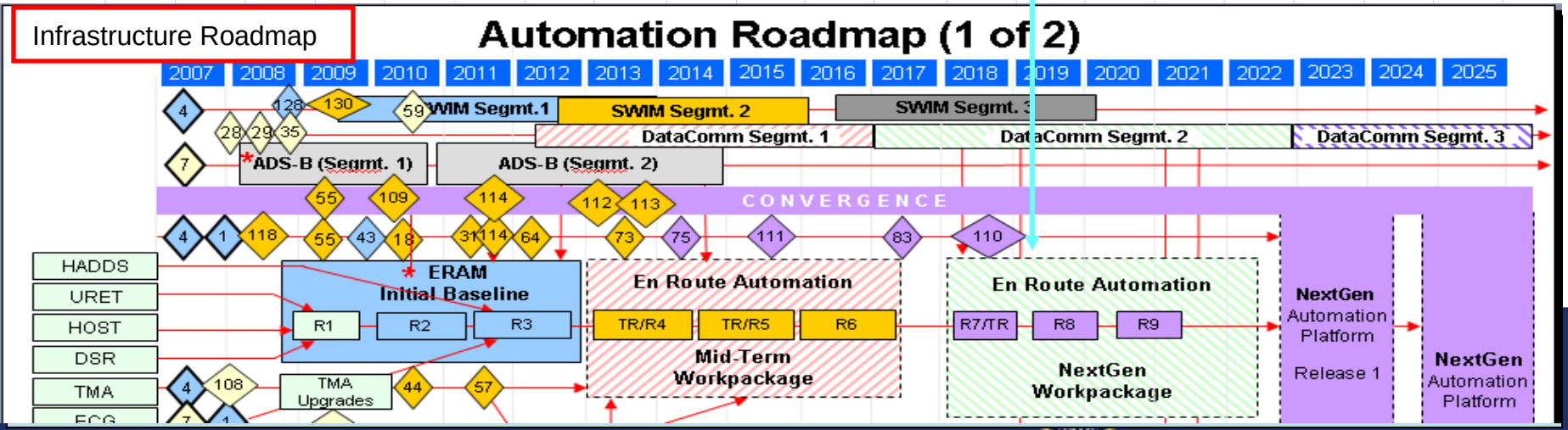
Sub-Capabilities

Tactical Trajectory Management

Etc. Etc. Etc.

Example

Infrastructure Roadmap



Current EA Focus Areas

- Integration of R & D activities – Roadmap Injection/Decision Pts (including TRL identification)
- Alignment of EA and Infrastructure Roadmaps with JPDO artifacts, OEP OIs & capabilities, NAS requirements, service roadmaps, IA artifacts, budget, Flight Plan, PWs, etc. – “connect the dots”
- Improved coordination with Service Units & development of criteria tailored to programs – EA is a communication tool (AMS criteria adjustments, PWC Recommendations, what goes to JRC vs. EC, etc.)
- Derivation of enterprise/NAS system level requirements derived from the OIs and OEP to support Service Unit planning - collaboration on what can be achieved given available BW
- EA “As Is” & “To Be” build out and development of incremental EAs (i.e., Mid Term, etc.)
- Packaging of EA artifacts for external use – Supplement to the Infrastructure Roadmaps (Executive Views)
- Demarcation of Enterprise to Service Unit EAs & artifacts and Service Unit to Projects

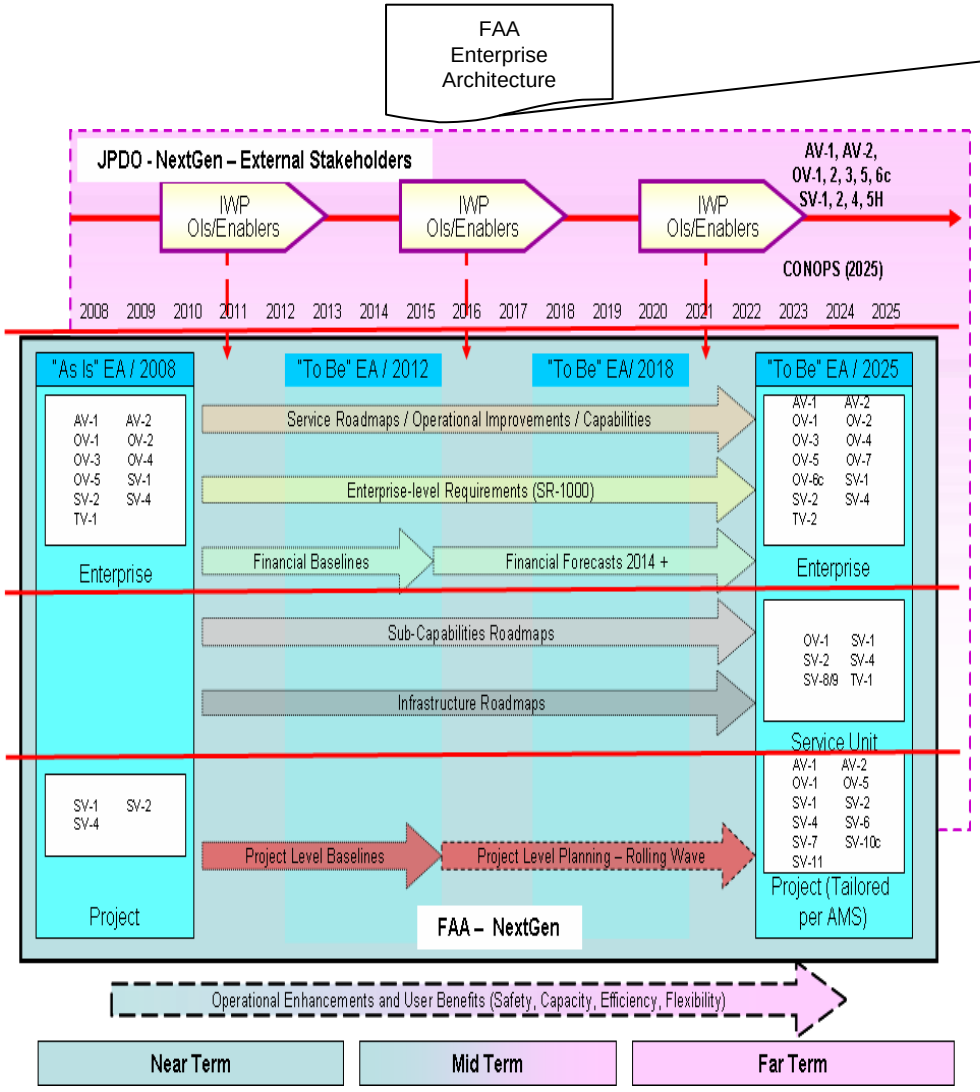
Current EA Focus Areas (cont)

- New EA Views – Security, Human-Centric, Fault Tolerance, etc. (e.g., use DoDAF views to highlight these areas)
- *CM & controls for EA evolution and maintenance*
- PMP for EA instantiation and enterprise use / processes
- Metrics to assess the effectiveness of the EA
- Enhancements to the NAS EA web site to improve navigation, access to information, common look and feel, etc.
- Enhance EA training and develop tailored courses for technical and management personnel. Short course for EA “big picture”
- Introduce sustainment efforts and legacy projects to establish a more complete picture of the EA and the roadmaps – look for opportunities to tie F&E efforts with Ops, RE&D, etc.
- Establish an “open season” for the EA update and tie in w/ EAB CM processes
- Processes for how new programs get injected into the CIP process and how $ are allocated for pre-implementation / CE / IA / target dates est.
- Supplement roadmaps and EA with information on: assumptions, dependencies, acquisition issues and strategy, resources, etc.

CM Initiatives for the EA

- Place EA artifacts under CM control
  - CM Plan currently being updated
- Establish formal mechanism for change control
  - Current recommendation is to place the new CCB under the existing NAS CCB
  - Benefits:
    - NASEA describes NAS systems already managed by the NAS CCB
    - Master Configuration Index and NASEA systems should be in sync
    - Final Program Requirements drive CM and should drive NASEA updates
    - NAS System requirements also under CM describe systems in the NASEA
    - Convenient for Systems Engineering to work with only one FAA-level CCB
- Manage relationships between domains
  - JPDO to FAA including FAA to external Agencies and stakeholders, Enterprise to Service Unit, Service Unit to Project

CM Framework



Approved Ex 300 Program Baselines

High Level Technical Requirements

Detailed Technical Requirements

Joint Resources Council

ATO Executive Council

NAS CCB
ATO-P
ATO-W

NAS Service Organization CCBs

Programmatic Baselines

Baseline Responsibility:
- OMB Exhibits 300
- Enterprise Architecture
- F&E Budget
- Data Standards
- Technology Standards
- NAS and Non-NAS CCB Charters

Baseline Responsibility:
- Final Program Requirements
- Top Level Requirements
- Interface Requirements
- External Interfaces
- Master Configuration Index
- Unallocated CIs
- FAA Standards (NAS CCB specific)
- Subordinate CCB Charters

Baseline Responsibility:
- Programs
- Interfaces
- Facilities

Summary

- Wrap Up and Discussion

For More Information:

FAA NAS Enterprise Architecture Website:
www.nas-architecture.faa.gov

FAA Operational Evolution Partnership site:
www.faa.gov/about/office%5Forg/headquarters%5Foffices/ato/publications/oep/

Joint Planning and Development Office site:
http://www.jpdo.gov/